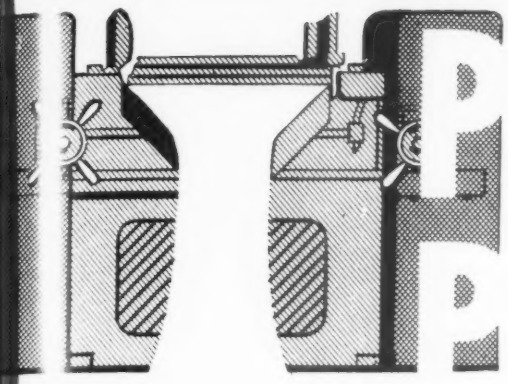

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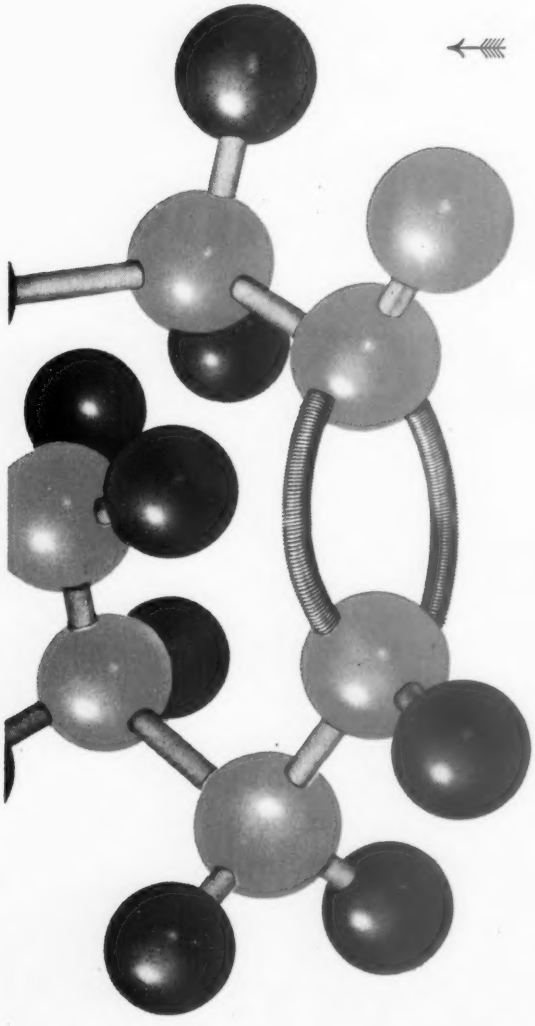

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(Established in 1911 as The Paint & Varnish Record)

VOL. XXX No. 9

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NEXT ISSUE

Our October issue will carry an interesting article on the use of filters in paint manufacturing. The author discusses the various types of filters employed, their construction, maintenance and cleaning.

CORRECTION

The article on Jar Mills which appeared in the August issue was written by *John O. Miller, Chief Draftsman, The U. S. Stoneware Co., Akron, Ohio.*

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Editorial Comment

Tung Oil Situation

A RECENT survey conducted by the *Journal of Commerce* has disclosed that Government allocations of tung oil are close at hand. This important ingredient of the paint and varnish industry is now in tight supply and current conditions here and abroad leave no choice for the Government except to institute controls so that military demands may be met.

The survey points out that imports from China are negligible as compared to a prewar figure of 100 million pounds. Domestic production of tung oil averages about 15 million pounds per year. However, it is expected that the 1950 output will amount to some 25 million pounds. Latin American countries will provide ten million pounds. With consumption amounting to about eight million pounds a month, it is apparent that our domestic production and South American imports are quite inadequate.

Prospects for increased production are gloomy. Frost has caused destruction of 95% of the tung crops in Florida, and 60–75% in Louisiana and Mississippi, according to the survey.

In view of these conditions, controls of tung oil are imminent and as one spokesman said, "It will be a resumption of tung oil's role in the last war when controls were drastic. Consumption had been trimmed down to below a million pounds a month and it was strictly a military commodity."

In this connection, it is interesting to note that the Colonial Development Corp., a British organization, is rushing plans for commercial scale production of tung oil in northern Nyasaland, Africa. Transportation and labor difficulties are hampering rapid development of this project and it will be sometime before commercial production is realized.

As a substitute for tung oil some raw material firms are now offering certain types of synthetic dimer acids. One firm in particular is producing, in commercial quantities, a new dimer acid which is a satisfactory replacement for part or all of tung oil in varnish formulations. This acid has also been successfully used with soya oil to reduce kettle time and to improve drying time and water resistance.

In this respect, certain combinations of tung-soya and tung-castor have been very advantageous in reducing the amount of tung oil used in certain formulations.

Paint manufacturers would do wise to investigate these compounds and combinations as possible substitutes for tung oil in formulations.

HERE in America, paint manufacturers are fully cognizant of the important work which is currently being done in other countries in the various phases of paint technology and manufacture. Those of us who have had the opportunity to keep abreast of foreign technical papers are well aware of the fact that our friends abroad are making considerable progress in the paint field.

In this connection, we proudly announce that the November issue of PAINT AND VARNISH PRODUCTION will be devoted to the technical developments in the paint industry both in the United States and abroad. Among those contributing to this International Issue are *Dr. A. V. Blom* of Switzerland, *Henri Rabaté* of France, *R. Arzens* of Belgium, *Dr. Dante Pagani* of Italy, *B. M. Letsky* of England, *Dr. Shinji Iwai* of Japan, *Dr. J. Hoekstra* of Holland, *Dr. Gerhard Zeidler* of Germany, *M. Hansen* of Denmark, *J. Anneveldt* of South Africa, *George Fearnley* of Canada, and *Dr. John C. Moore* of our National Paint, Varnish and Lacquer Association. All of these men are top technologists and are fully qualified to comment on the developments and progress made in their respective countries.

This will be the first International issue in the history of the paint industry, and will afford an opportunity to learn and compare the paint manufacturing techniques and developments throughout the world. Watch for it!

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Saponification Value	196 - 200
HEAT STABILITY: After heating to 235° C for five hours with CO_2 Color-Gardner Standards 1933	5 - 7

HARDESTOIL 16

Titre	(42.8 - 48.2° F) 6.0 - 9.0° C
Color-Gardner Standards 1933	3 - 5
Iodine Value (Wijs)	minimum 135
Free Fatty Acid (as oleic)	96 - 98%
Acid Number	191 - 195
Saponification Value	192 - 196
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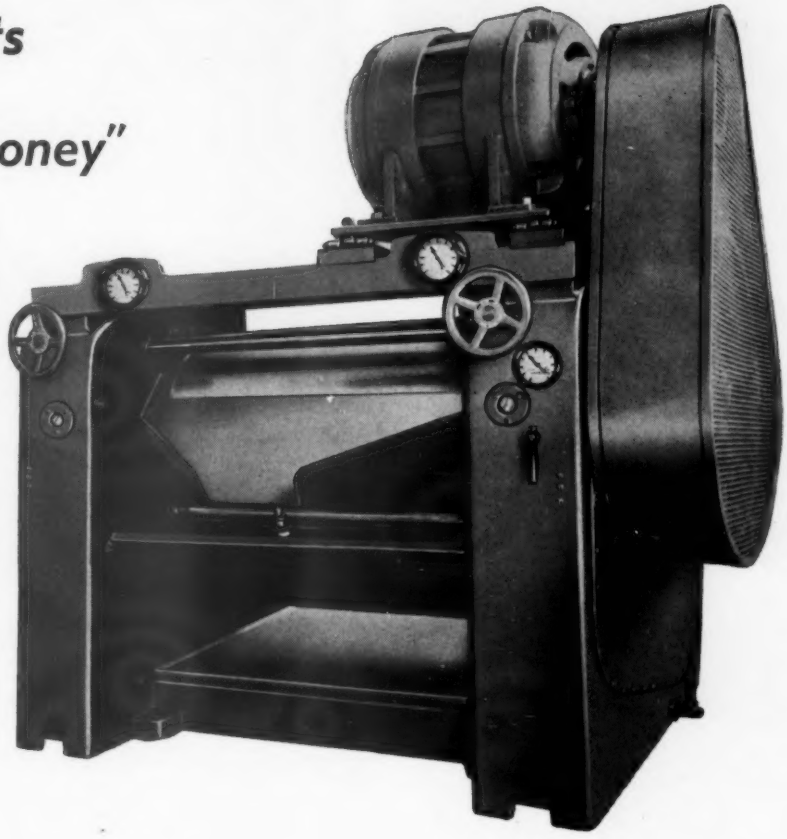
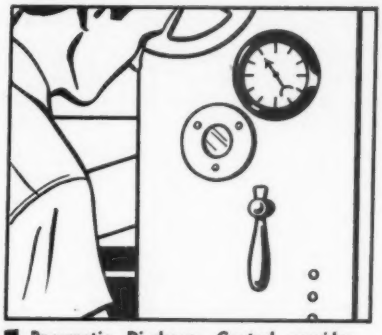
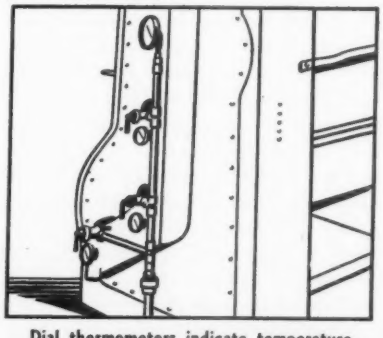


Operator can see instantly roll pressure effects caused by handwheel adjustments.



Pneumatic Discharge Control provides means for setting knife pressure for most efficient take-off.



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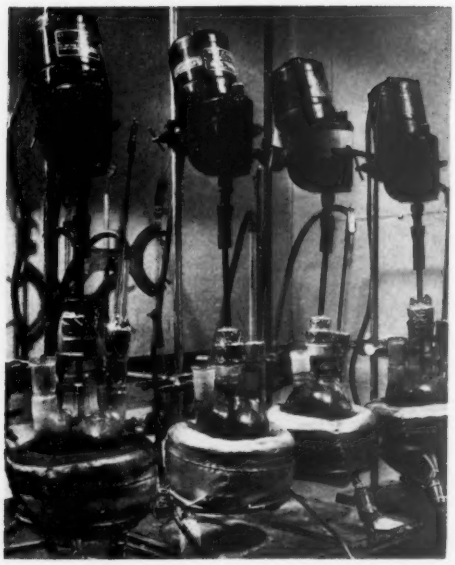
Small test cells are used for studying ability of coatings to resist corrosive chemicals.

Coatings Research at Battelle Memorial Institute

By E. R. MUELLER and B. G. BRAND
Battelle Memorial Institute,
Columbus, Ohio



Reaction vessels are used in preparing varnishes and alkyds for enamels and finishes.

ONE of the major problems confronting industry today is the prevention of corrosion and deterioration of its products. One of the more important methods of furnishing protection to products is the use of protective organic coatings. In most cases, these coatings also impart a decorative "finished" look to the product, and thus enhance its value. Therefore, the establishing of facilities to study protective and decorative coatings was undertaken very early in the development of Battelle Memorial Institute.

It has been only very recently that science has played a major role in the development of protective and decorative coatings. Prior to that time, the industry was largely, if not wholly, classified as an art. In fact, it is still about as much an art as a science. Consequently, much research on protective and decorative coatings remains to be done. Better coatings and better methods of using present coatings are two of the important problems facing the industry today. Battelle Memorial Institute is aiding in solving these problems of industry by its research in many fields.

One of the provisions of the will of the late Gordon Battelle established an endowment to encourage industrial research. As a direct result of this provision, Battelle Memorial Institute was founded in 1929 "for the purpose of education—the encouragement of creative research —and the making of discoveries and inventions" for industry.

Since the founding of this Institute, it has served more than a thousand sponsors by developing new materials, products, and processes, and by improving old ones; by reducing costs and rectifying the causes of manufacturing failures; by making technical-economic studies; and in many other ways assisting industry through research.

As presently organized, the Institute comprises 34 research divisions, each engaged in research and development in its own field. Cooperation between divisions is encouraged to the point where the personnel and facilities of two or more divisions are often jointly utilized to accomplish a successful solution to a problem.

Any individual, group, or corporation underwriting work at Battelle is known as a Sponsor. Upon acceptance of a project, a contract is executed between the Sponsor and Battelle, fixing a definite upper limit on the costs to the Sponsor, and providing that all discoveries and patents made on this project during the period of the contract are the property of the Sponsor. The contract also provides that no publication of the work can be made without consent of the Sponsor.

Classification

COATINGS research at Battelle may be roughly classified into three main groups: (1) the development of special-purpose coatings, (2) development of new raw materials that are not currently used or only very rarely used in protective and decorative coatings, and (3) fundamental research.

Special-purpose coatings to perform a specific function are in great demand. Often the potential volume of such coatings is not sufficient to justify costly research by the coatings producers. Battelle undertakes such research for the user, supplying him with a formulation which he can then turn over to his coating supplier for production of a material that will serve the purpose.

New materials are constantly becoming available on the raw-material market. One of the functions of Battelle involves a thorough study and examination of raw materials for the producer before these materials are placed on the market, with the specific aim of determining the value of the material to the coatings industry. Often this work entails developing specific formulae for suggested uses of the material, and obtaining the required "know-how" for successful application to intended uses.

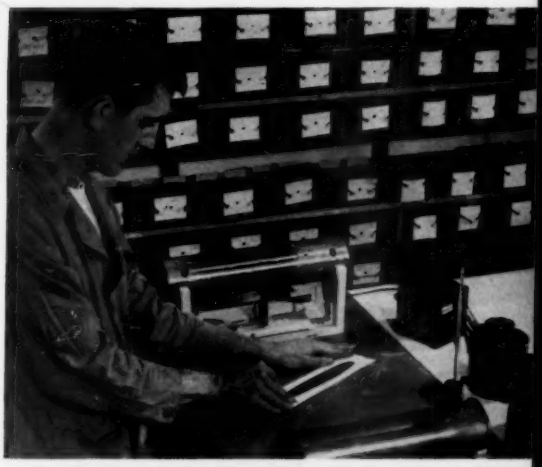
A number of fundamental studies on coatings and resins have been carried out at Battelle, mainly for Governmental agencies. These stud-

Atmospheric exposure under seaside conditions at Battelle's North Florida Research Station.

Above instrument measures resistance to break-down of films under electric voltage.

Closeup of panels after exposure to marine fouling. Several types of fouling organisms may be noted above.

Tide water exposure at Florida. At high tide, panels underneath pier are immersed; at low exposed to air.



Black draw-down on piece of paper is a specimen of high-speed printing ink. Drying time of ink is noted.

ies have been concerned with the physical properties of organic coatings, a study of the chemistry and physics of the interface layer between the coating and substratum, and a study of the possibilities of developing a new test method to predict the service life of protective organic coatings. From the latter study has emerged a new line of investigation of the electrical properties of coatings and their relation to the physical behavior of the coating under service conditions. This study has not been completed and is at present inactive, but there are reasons to believe that it offers considerable promise. The work was based on the belief that materials exist at the interface that differ in electrical properties from the coating or the substratum, and that these materials influence the adhesion and other properties of the coating film.

The coatings laboratory is also concerned with assisting other Battelle research divisions to a successful solution of their problems. New alloys developed by the metallurgical divisions often require special primers and coatings to permit their successful application to certain uses. New uses for already well-known materials often require a special study of coatings to permit the desired base material to be used. Here is an excellent example of cooperation between divisions to obtain a successful solution to a difficult problem.

Scope

A few examples of problems now in progress or successfully completed will serve to illustrate the scope of coatings work done at Battelle.

The Steel Shipping Container Institute is an alliance of most of the manufacturers of steel containers, such as steel drums, pails, etc., for the benefit of the industry as a whole. Battelle is engaged in a project, sponsored by this Institute, to select or develop coatings for the interior of steel containers that will permit shipping of materials in steel drums that now require more costly containers, such as glass carboys or stainless steel or galvanized drums. This project involves, first of all, a study of the surface conditions of the steel to give optimum performance to any coating, and, secondly, a choice of a suitably resistant coating to protect the steel from being attacked by the contents, in one case, and to prevent contamination of the contents with iron, in the other case. The investigation has already progressed to the point where it is now possible to ship several materials in lined steel containers that previously required stainless steel or glass containers. Results are being obtained that indicate many additional materials may soon be placed in this category.

One of the largest problems confronting the *Armed Forces* is the protection of equipment from the rigorous conditions found in the tropics. Radio and radar equipment are particularly susceptible to attack from fungi. A large program is under way, and nearing completion, on the selection of the most effective coatings and fungicides and fungistatic agents for the protection of electronic equipment in tropical atmospheres.

A similar problem is the protection of electronic equipment operating at elevated temperatures. For example, Battelle has recently developed a protective coating for carbon-film resistors that protects the carbon film from oxidizing when operating at 200° C. This temperature is far in excess of the present maximum temperature of 85° C. and will permit a more varied application of electronic equipment to more rigorous conditions than was previously possible.

A large project, extending over several years, has been completed with the development of a highly effective antifouling coating for use on ships' hulls. This coating has proved superior in laboratory tests and on test ships, and is now in commercial production. It is particularly effective in controlling growth of barnacles and other fouling organisms.

A study of corrosion-resistant primers for steel prefabricated houses has been completed recently. This project was carried out in cooperation with Battelle's corrosion laboratory and was designed to reduce corrosion difficulties resulting from condensation of moisture between the interior and exterior walls of dwelling houses constructed of steel. Evaluation of a series of corrosion-resistant coatings and primers has resulted in selection of the most promising materials for this use, on the basis of laboratory tests.

Techniques for using low-cost hydrocarbon resins in the fast-drying and smear-resistant inks have resulted from one project at Battelle. As a result of this study, high-quality fast-drying heat-set inks suitable for use on high-speed printing presses can now be produced with these low-cost resins.

Raw Materials

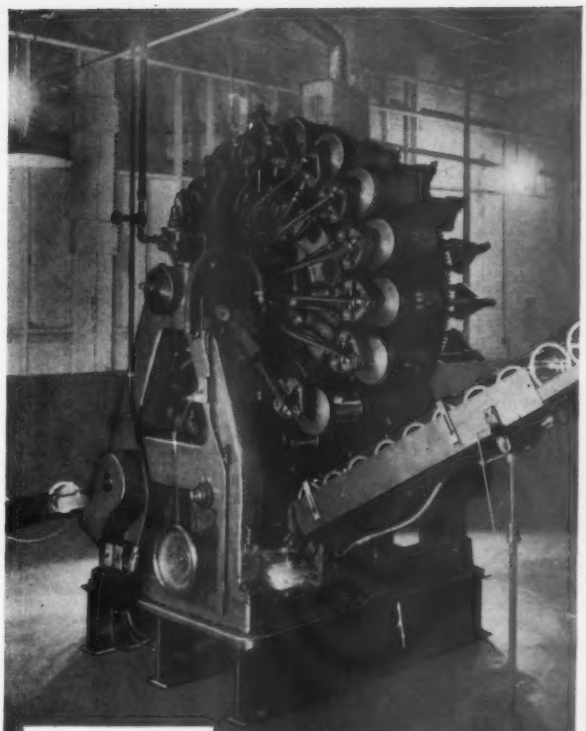
IN the field of raw-material development considerable work has been done at the Institute on the utilization of tall oil in coatings. Tall oil is a by-product of the paper industry, comprised largely of rosin and fatty acids. It is an inexpensive raw material, and has considerable potential value as a component of a large number of coating types. This project has dealt mainly with developing formulae for the substitution of tall oil for conventional materials in oleoresinous varnishes, alkyds, etc., as well as improving the quality of the tall oil to permit a superior product to be marketed.

The utilization of certain petroleum by-products that have drying characteristics useful for coatings has likewise been the subject of a project at Battelle. This project has been successfully completed with the development of a series of formulae for use of the by-product in such applications as railroad freight-car paints, concrete coatings, interior wall paints, and water-emulsion paints.

A similar project on a new experimental hydrocarbon drying oil, not yet available on the market, is now under way. Several projects of a similar nature have been undertaken in the past, with the goal of finding new uses for products such as resins, in order to expand their potential market, and to develop formulae for their satisfactory use.

Still another type of work that has been carried out at Battelle is illustrated by a project that has recently been completed. This project was concerned with the effects of red-lead paints on the weldability of structural steel. A series of red-lead paints, as well as zinc chromate primers, were evaluated for their effect on the quality of metal arc-

(*Turn to page 20*)



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The Use of Styrene in PROTECTIVE COATINGS

AT the risk of repeating common knowledge, it should be mentioned that styrene has only been produced in commercial quantities within the last decade. This material was transformed from the status of a laboratory curiosity to a tonnage chemical in a short space of time, because of its warborne use as one of the principal ingredients of GR-S type synthetic rubber.

It had been known for some considerable time that styrene could be induced to polymerize. This polymer, known as polystyrene, is extremely hard, water-resistant, pale in color, easily molded, and possessing high dielectric strength. It is natural that such a material should be the object of attention from the protective coating industry, and many attempts have been made to utilize it in coatings. Polystyrene as a film former suffers from several disadvantages. It has poor adhesion, is very brittle, and has poor resistance to aromatic solvents. Various methods were tried in an effort to overcome these disadvantages. It gradually became evident that modification of styrene with drying oils would be the best method of obtaining a product acceptable to the protective coating industry. Research in this field commenced in Great Britain in 1942, in the United States about the same time, and in Canada in 1946, making use of some of the information already available.

The process of reacting styrene with another chemical, such as a vegetable oil, has become known as styrenation. While this is not a particularly happy term from the chemical point of view, it has become very widely used and will continue to be used in this paper.

It should be said at the outset that the development of styrenated products has in the whole, proceeded empirically and with very little theory to guide it. With the development of reproducible, usable materials, theories are being developed to explain the observed behavior.

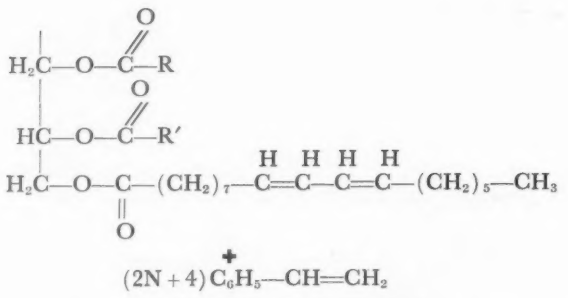


Figure 1

Styrenated Oils

THE first stage in the utilization of styrene was the development of so-called styrenated oils. In these products styrene and similar reactive monomers are reacted with one or more vegetable oils. Two processes are available for the reaction. The first is the solvent method of copolymerization, developed to a large extent in the laboratories of Henry Berger and Sons and described by Hewitt and Armitage (1), and the second is the mass method pioneered by the Dow Chemical Company and described in bulletins by that Company (2).

Styrene can be reacted with most drying and semi-drying oils, but the products are not all necessarily suitable for coating use. Generally speaking, the presence of conjugated unsaturation is desirable for smooth reaction to yield a homogeneous product. The presence of 9, 11-octadecadienoic acid in the triglyceride molecule is desirable. Unconjugated multiple unsaturation of the type present in linoleic and better linolenic acid will also react, although less smoothly. Dehydrated castor oil is the best available source of the 9, 11-octadecadienoic acid, and has been found to produce the most satisfactory results. This is true both of the actual reaction and the characteristics of the product. A critical summary of the exact characteristics necessary in the dehydrated castor oil has been presented by Hoogsteen, Young and Smith (3).

* Presented before the Fourth Annual Regional Meeting of the Protective Coatings Division, The Chemical Institute of Canada, March 1950, at Montreal, Que.

Catalyst

IT is usual to speak of the use and presence of catalyst in styrenated oils. This usage is incorrect, since a catalyst by definition is a material which changes the rate of reaction without chemical change in itself. It may accomplish this change purely by surface effect, or it may take part

By T. H. GLYNN MICHAEL
Woburn Chemicals, Ltd.
Toronto, Ontario

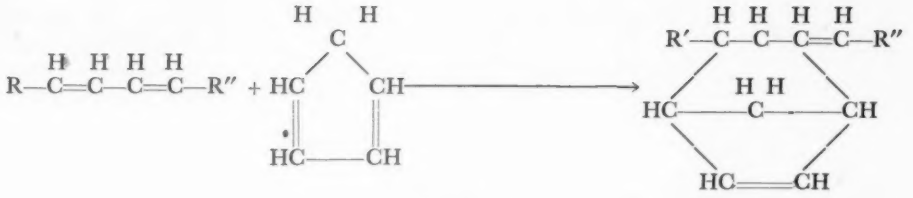
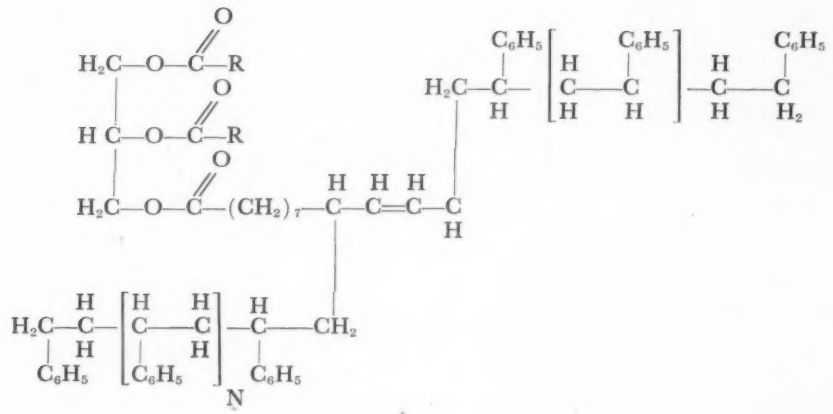


Figure 2



where $N \geqq O$

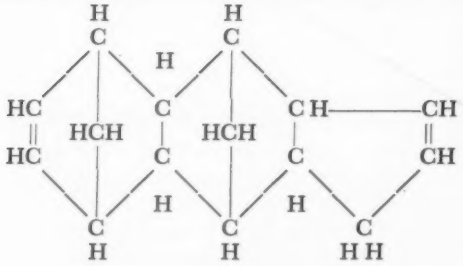


Figure 3

chemically in the reaction, being regenerated at the end of the reaction. The oxygen-donating materials used in the styrenation are decomposed, and should properly be referred to as accelerators rather than catalysts. Benzoyl peroxide and cumene hydroperoxide are the accelerators commonly employed. Blown oils of high peroxide value may be used as self-accelerators but they suffer from two drawbacks. A blown oil is necessarily more costly then an unblown oil, and secondly the blown oils show less color stability and resistance to yellowing than unblown oils.

Commercial styrenated oils are based largely on soya or dehydrated castor oils. Compared together, the styrenated D.C.O. shows better durability, stability, color retention, and in some cases odor, than the styrenated soya. These advantages more than compensate for the higher cost of the styrenated D.C.O.

Characteristics

STYRENATED D.C.O. has the following characteristics, which of course are carried into finishes whose formulations are based upon it.

1. Rapid dry. Films are dry to handle under usual conditions in 45 minutes, and this suggests the use of the material in "2 hours" household enamels.
2. High Gloss. Enamels may be formulated with pigment/binder ratios in the range 1/1 to 1/1.25 having a gloss value of over 90%.
3. Hardness. Enamels can be formulated to yield a Sward hardness of over 40 after 18 hour air dry. On submission to a baking schedule of 45 minutes at 250° F. a Sward hardness of 50–60 may be obtained.
4. Anti-Settling. Enamels formulated with this type of vehicle show a pronounced resistance to settling, even though a high proportion of prime pigment be used. No numerical evaluation of this property is available, but the effect is striking.
5. Durability. Under certain conditions the durability is excellent. This is particularly true on metal, and wherever expansion and contraction of the substrate is not too marked.
6. Applicability. Formulations for brushing, spraying, dipping, and roller-coating may all be readily prepared.

Drawbacks

LEST this list may cause the reader to think that a universal coating vehicle is at hand, some drawbacks of the material must be listed.

1. Marrability. Even though very hard, some finishes are subject to marring by glancing blows.
2. Solvent resistance. Resistance to aromatic hydrocarbons is poor, and to aliphatic hydrocarbons such as mineral spirits and gasoline is only fair.
3. Chemical Resistance. In general fairly good, alkali resistance being of a higher order than that of alkyd resins of comparable oil content.
4. Durability. When applied to wood, the coating fails fairly rapidly by cracking, when exposed to accelerated weathering tests. Resistance to outdoor weathering appears better than would be expected from the accelerated tests.

In considering the composition of styrenated oils, it should be noted that the ratio of oil to styrene may be varied within fairly wide limits, and still result in a satisfactory product. By "satisfactory" is meant absence of objectionable haze, in addition to other characteristics. This means that either a solution of oil and styrene is formed, or that a compound is formed whose exact composition may be varied. The first possibility is ruled out by the fact that the reaction conditions employed (heating at a minimum of 290 F. in the presence of an oxygen-donating accelerator) would lead in the course of a short time to the formation of polystyrene, with consequent precipitation and instability. This would occur even if a clear homogeneous solution was initially formed. It would appear therefore that a chemcial compound must be formed. The smoothest reaction takes place in the presence of a triglyceride one or more of whose fatty acid radicals contain conjugated unsaturated double bonds. A mechanism has been proposed for the reaction of styrene with butadiene. The triglyceride mentioned may be considered as a substituted butadiene, and it is reasonable to assume that the same reaction would take place. The reaction may be described in Figure 1. Examination of this equation will show that for N-O the weight ratio of triglyceride to styrene is 874/416 or approximately 2: 1 and it has been confirmed experimentally that this is about the least proportion of styrene that may be successfully used in the reaction. This presupposes that roughly one third of the fatty acid radicals of D.C.O. are the reactive, conjugated 9, 11 isomer and two thirds the less reactive 9, 12 isomer. This corresponds closely with the analysis of commercial D.C.O. products. This equation indicates how increasing amounts of styrene may be incorporated into the molecule, and in practice it has been found that a triglyceride/styrene ratio of up to 1/3 can be used. However, a ratio of 2/3 gives a product having the best balance of properties for a general purpose product.

Styrenated Alkyds

THE second major application of styrene to protective coatings is the so-called styrenated alkyd. Since an alkyd consists in essence of a triglyceride oil combined with glyceryl or pentaerythrityl phthalate, it is easy to see that styrene could be combined with the oil portion of such a molecule. The theory of composition and formation is similar to that discussed for the styrenated oil.

Such a product may be synthesized through several different paths:

1. A styrenated oil may be subjected to alcoholysis and the resulting product reacted with phthalic anhydride.
2. A fatty acid may be copolymerized with styrene and this product reacted with an alcohol and phthalic anhydride.
3. An oil may be subjected to alcoholysis to yield a monoglyceride, which may then be styrenated, and the resulting intermediate treated with phthalic anhydride in the usual way.
4. An alkyd containing all the usual ingredients may be copolymerized to yield a styrenated product.

The properties enumerated above for styrenated oils are carried over into styrenated alkyds. What may be called the alkyd portion of the molecule enhances the rapid dry, solvent resistance, chemical resistance, and durability. It is obvious that for any one set of ingredients an infinite number of compounds of varying proportions may be formed. It appears that commercial products are gradually crystallizing into two groups, which may be called "short" and "long", although these adjectives have not the exact meaning which they possess in referring to conventional alkyds. The approximate percentage compositions by weight of these two groups are given Table I.

(*Turn to page 20*)

Table I

	Short	Long
Oil	20–30	30–40
Phthalic Anhydride	20–30	25–35
Glycerol	10–20	10–20
Styrene	30–40	15–25

paint grinding BALLS made of improved alloy cast iron

Fig. 1. Martensitic cast iron. Free carbides (white islands) in martensite matrix. 500x.

By KENNETH A. DeLONGE
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International Nickel Co., Inc.
New York, N. Y.

THE search for longer lasting abrasion resisting metals is a constant one in industry. Over the last twenty years the operators of plants grinding metallic ores, cement, coal, sand and various industrial minerals have learned that it is very often advantageous for them to use hard martensitic white cast iron parts where they had regularly been using either cast or manganese steel, forged steel or unalloyed (pearlitic) white iron.

The longer life of this special hard white iron greatly reduces metal replacement and maintenance costs and produces greater overall efficiency of operation.

The most commonly used martensitic white iron is marketed under the trade name Ni-Hard*. This iron is alloyed with nominally 4½% nickel and 2% chromium, an alloy content which produces castings in the mold cooled condition which are 600–700 Brinell hardness and possess engineering properties 25–50% greater than those for unalloyed white iron. Of greater importance to the mill operator is the fact that martensitic white iron lasts 100–200% longer than unalloyed white iron parts and 30–200% longer than a variety of cast and forged steels.

The typical composition and properties of martensitic white iron are given in Tables I and II.

* Reg. U. S. Patent Office. The International Nickel Company, Inc.

Chemical Analysis

Total Carbon	2.50–3.50
Graphitic Carbon	0.10 max.
Silicon	0.40–0.70
Manganese	0.40–0.70
Sulfur	0.15 max.
Phosphorus	0.40 max.
Nickel*	4.00–4.75
Chromium	1.40–3.50

* Note: Nickel content as low as 3.00% permissible for certain small castings such as ¾–1" diameter grinding balls.

Table I

Properties

Brinell Hardness	550–650
Rockwell "C" Hardness	55–61
Tensile Strength	40–50,000 p.s.i.
Specific Gravity	7.70 g. per cc.

Table II

Fig. 2. Typical hardened 0.80 carbon forged steel. Structure is martensite. Mag. 500X.

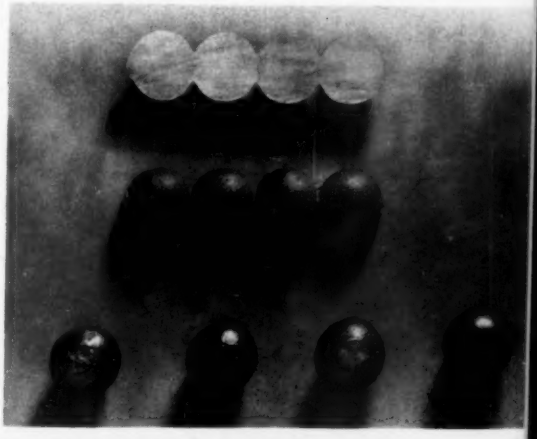


Fig. 3. ⅞" diameter martensitic white iron grinding balls showing they are cast in strings. (Center). Sectioned string at the top shows the soundness of the balls. Balls at the bottom as they appear after dry tumbling at the foundry. *Courtesy of Pennebacker Co., Emmaus, Pa.*

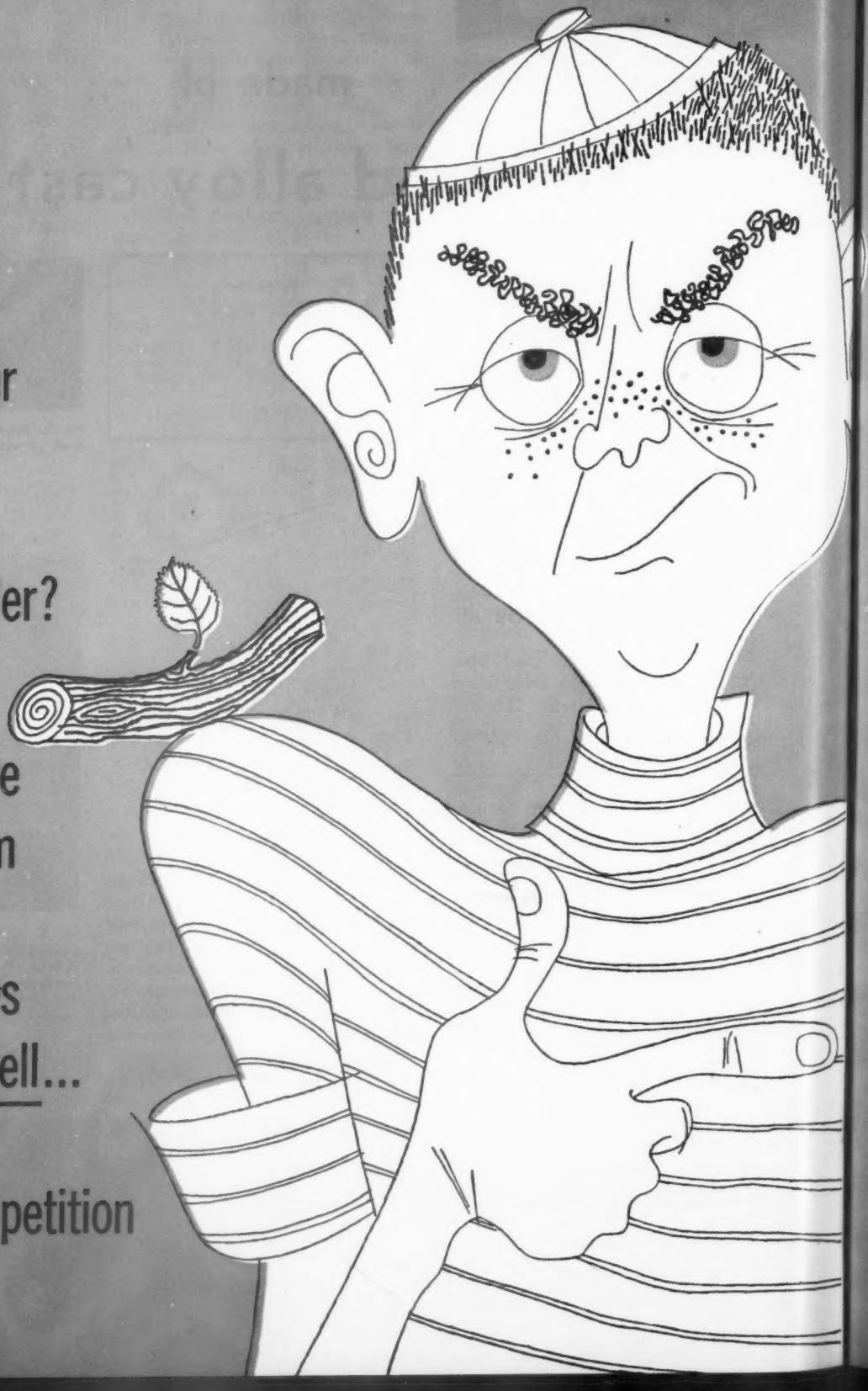
Comparison with Steel

IT will be noted that the hardness of this iron is not above that of hardened steel and yet years of field experience have proven that this iron will outlast hard steel in abrasion resisting service by as much as 30–100%. The reason for this apparent paradox is to be found by comparing

(*Turn to page 22*)

Fig. 4. View looking into 2 feet by 3 feet grinding mill loaded with ¾ inch martensite white iron balls. Photograph was taken after approximately five months of service.

Take that chip off his shoulder...



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. . . STYRENE

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The outstanding properties of the short type are rapid dry of the order of 5–10 minutes, gloss, extreme hardness in the air dried and baked films, and much superior chemical and solvent resistance to that displayed by the styrenated oils. Durability is very good. The long type displays much the same properties, but with a slower drying time, somewhat lower hardness, and better durability characteristics. The short type may only be applied by spraying, while the long type may be formulated for brush application. Drawbacks of the material include a rather low order of mar resistance, limited compatibility with other film formers and wetting properties which are not of the highest order.

A list of representative uses for the styrenated materials discussed is given in the following list.

Styrenated Oils: Two hour enamels, Traffic paints, Aluminum paints, Screen pastes, Wood sealers.

Short Styrenated Alkyds: Quick drying spray enamels for Machinery, Implements, Signs, Toys, Metalwear, Wood sealers.

Long Styrenated Alkyds: Architectural enamels, Machinery and equipment enamels, Brushing refinishing enamels, Brush application sanding primer.

Certain practical difficulties must be kept in mind which have a bearing on the manufacture of these materials, although they in no way affect their use. The handling of styrene monomer requires the observance of a series of precautions, in order to avoid premature polymerization or on the other hand, polymerization inhibition. The restricted compatibility of the finished products makes necessary a complete system devoted entirely to the processing of this type of material.

Other Co-polymers

MANY other reactive and polymerizable monomers have been proposed as being suitable for co-polymerization with drying oils. These include cyclopentadiene, butadiene, allyl alcohol and its derivatives, acrylonitrile, maleic anhydride. Of these, the use of maleic anhydride in the formation of so-called maleic adducts is well known. The use of cyclopentadiene has progressed further than any of the other compounds listed. This chemical will co-polymerize in a Diels-Alder type of reaction with fatty acid radicals containing a double bond. This chemical is supplied in the form of a dimer, stable at room temperatures. It appears to decompose reversibly to the monomer on heating, the monomer being the reactive form. The simplified reaction may be pictured in Figure 2.

It can be readily seen that from 1 to 6 molecules of cyclopentadiene could react with one triglyceride of linoleic acid molecule. Since cyclopentadiene can readily dimerize and trimerize it is probably that cyclopentadiene chains of the type shown in Figure 3 can be formed across fatty acid molecules, in an analogous manner to the formation of styrene co-polymers.

Products of this type are commercially available, and can be used as varnish oils and as sole vehicles, depending on the degree of modification with cyclopentadiene.

An endeavor has been made in this paper to cover briefly the chemistry involved in styrenated oils and alkyds, and to point out the characteristics of these compounds, together with the properties imparted by them to coatings.

It is trite to say that chemistry is playing a more and more important part in the production of protective coatings, but it is nevertheless true. It may be of interest to attempt briefly to forecast future development in the field of chemically developed coating vehicles. The present co-polymer oils and resins have not by any means reached their final state. Inter-polymers between more than one oil and more than one reactive monomer are now in process of development, and they give promise of providing even more desirable properties. The use of monomers not now considered is very likely. Taking a further step into the future it is not unlikely that such monomers will be used to modify not vegetable oils, but standard hydrocarbon derivatives of a definite composition, having their origin in the petrochemical field. While such a development may not come about in one year or two, it should serve to produce a much more stable price structure. Fluctuating prices have been the vane of the paint industry, and any developments which tend to correct the situation, and at the same time supply more uniform, more versatile, and more desirable vehicles, should receive the general support of the protective coating industry.

References

(1) Hewitt, D. H. and Armitage, F., J. Oil Colour Chem. Assoc. 29, 109–28/46.
(2) Dow Chemical Company "Styrenated Drying Oil,, Rev. Ed. Feb. 1948.
(3) Hoogsteen, H. M., Young, A. E., and Smith, M. K., Div. of Paint, Varnish and Plastics Chemistry, American Chemical Society, Reprint Booklet, September, 1949.

* Presented before the Fourth Annual Regional Meeting of the Protective Coatings Division, The Chemical Institute of Canada, March 1950, at Montreal, Que.

. . . BATTELLE

(From Page 12)

welds made on the coated members. Such factors as operating characteristics of the electrodes, the internal soundness of the welds, and mechanical tests of the welded joint were evaluated. The results showed that satisfactory welds in general could be obtained with all coatings tested.

Facilities and Equipment

BATTELLE is well equipped for almost any kind of coatings research work. The usual equipment for mixing and grinding, including such items as a variety of types of ball-mills, a laboratory-size 3-roll mill, pony mixer, Banbury mill, drill-press mixer, and dough mixers, are available for use, and may be employed in making a wide variety of types of coatings. In addition, a 2-roll mill is available for chipping and sheeting of resins and mixes.

Facilities for applications by dipping, roller-coating, brushing, or spraying are available, including a water-wash spray booth $4' \times 5' \times 5'$ inside dimensions.

Ovens of various types and sizes are available to study curing of films under a wide range of conditions found in commercial practice.

Testing equipment is available to furnish all the usual data, such as film thickness, flexibility, adhesion, resistance tests of many kinds, etc. Such equipment includes a General Electric magnetic-type plating-thickness gauge, Interchemical wet-film-thickness gauge, Bathytrol thickness gauge, Pfund cryptometer, Taber abrader, and several types of vis-

cometers, including a Stormer, Brookfield, MacMichael, Ford cup, etc. In addition to the above usual equipment, many special test devices have been developed to obtain information of an unusual nature. For example, test cells have been devised to evaluate coatings for application to steel shipping containers that closely simulate conditions encountered in actual use in steel drums. Stability testing apparatus is also available for studying dip-tank behavior of coatings with age.

A well-equipped varnish laboratory is available, in which varnishes, alkyds, and other resins may be cooked under a wide variety of closely controlled conditions, including solvent reflux, various inert atmospheres such as carbon dioxide or nitrogen, and open kettle.

Exposure Testing

A constant-temperature, constant-humidity room, maintained at 78° F. and 50 per cent relative humidity, allows air-drying and aging of films to be done under A.S.T.M. specified conditions. This room is also very useful in carrying out many tests that require measurements to be made under carefully controlled conditions.

A wide variety of exposure conditions are available for testing the life of coatings and their protective ability. Exposure fences are maintained in Columbus, Ohio, and near Daytona Beach, Florida. The fences at Columbus, Ohio, are strategically located to obtain a balance between fresh country air and industrial atmospheres. Exposure under strong industrial atmospheres can also be studied, if desired. At the Florida test site, exposures under total sea water, air and sea water, and half-tide immersions can be made. Test fences for air exposure are located both on the seashore and two miles inland, giving both salt-spray effect, and semitropical effect with no salt spray. Exposures under special conditions can also be made, such as pilings that extend from the mud zone through sea water and into the air. The action of marine fouling organisms, such as barnacles, bryozoa, oysters, and algae, can be studied at this site.

The facilities of this Florida test site are available to industry for exposure of coatings to the conditions enumerated above. Grading of the panels may be carried out by the personnel of the test station on any desired schedule, or arrangements may be made for a representative of the sponsor to inspect the panels if desired.

In addition to the above normal exposures, accelerated test-equipment is available. The National Type X-1A accelerated weatherometer has proved extremely useful in determining the merits of a coating system in a preliminary manner. Salt-spray cabinets are also available for determining the corrosion resistance of coating systems on metals. A tropical room 18 × 30 feet is maintained at 86° F. and 98 per cent relative humidity for testing of coatings under these specific conditions. Various fungus cultures are available for use in this test. In addition, test cabinets are available for testing specimens over a wide range of humidity and temperature conditions depending on the intended application of the material being tested.

Personnel

WORK in the coatings laboratory is under the direct supervision of *E. E. McSweeney*, the Chairman-Elect of the Paint, Varnish, and Plastics Division of the American Chemical Society. Advisor on coatings research and other chemical research is *P. O. Powers*. Dr. Powers is well-known for his work on coatings and drying oils, and for his many publications.

The personnel of the coatings laboratory include engineers having a wide variety of previous experience in the industrial production of coatings and their raw materials. This experience has been proved to be a valuable asset in aiding the quick solution of many problems.

Much of the research work at Battelle has been published in the technical literature, and several papers on various subjects are currently being prepared for publication. References to previous coatings work at Battelle include the following publications:

1. "Preparation of Tall Oil Ester," E. R. Mueller, P. L. Eness, and E. E. McSweeney. Preprint Booklet, Division of Paint, Varnish, and Plastics Chem., March-April, 1949.
2. "Drying Oils and Resins from Petroleum Sources," R. J. Lee, L. M. Adams, and E. E. McSweeney. Paint, Oil, and Chem. Rev., January 8, 1948.
3. "A Study of Paints for Enclosed Structural Members in Steel Housing Construction," H. A. Pray, and R. S. Peoples. Contributions to the Metallurgy of Steel, No. 31, American Iron and Steel Institute, N. Y., May, 1949.
4. "Drier Requirements for Tall Oil Vehicles," E. R. Mueller and E. E. McSweeney. American Paint Journal, **34**, No. 11, Page 26, December 5, 1949.
5. "Linings for Steel Shipping Containers," L. F. McKay. C & E News, **27**, No. 50, Page 3694, December 12, 1949.
6. "Chemical Reactions in the Varnish Kettle," P. O. Powers. Official Digest, July, 1947.
7. "Mechanism of the Oxidation of Drying Oils," P. O. Powers. Ind. Eng. Chem., February, 1949.
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10. "Solubility of Polystyrene in Hydrocarbons," P. O. Powers. Ind. & Eng. Chem., January, 1949.
11. "Organic Coatings for Metals," E. E. McSweeney. Plating, **35**, No. 4, Page 340, April, 1948.
12. "Studies on the Effects of Red Lead Paints on the Quality of Metal-Arc Welds in Structural Steel," R. W. Bennett, R. D. Williams, and C. B. Voldrich, Welding Journal Research Supplement, November, 1947.

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. . . GRINDING BALLS

(From Page 17)

the microstructures of the two metals. The martensitic iron (Fig. 1) possesses a multitude of free iron carbide which has a hardness of approximately 900 Brinell while the typical hardened steel (Fig. 2) part used for abrasion resisting service possesses no free carbide. Both materials are martensitic in nature but the combination of the excess carbides in martensite gives the iron base material its definite advantage in resisting the scouring action of the abrasive in grinding and milling operations.

Only in the last three or four years has attention been given to the casting of grinding balls in martensitic white iron. It is in this connection that this iron is of particular interest to paint manufacturers because in recent months methods have been perfected of casting sound small diameter balls in sizes regularly used in paint grinding or mixing.

A number of paint producers have now investigated the results obtainable with martensitic white iron balls in sizes of ⅝, ¾, ⅞ and 1″ diameter. The following are typical of the results reported: (1) Using ¾″ diameter balls grinding magnesium silicate in mineral oil, Ni-Hard showed a superiority of approximately 2:1 over two types of hardened steel balls as shown in Table III. (2) A midwestern paint plant using ⅞″ balls reported some interesting results: (see Table IV).

Ball Material	Hardness Rc	% Wt. Loss in 5,000 Hours
Ni-Hard	58	5.52
Steel A	63	11.35
Steel B	61	12.95

Table III

Ball Material	Wt. Loss (lbs.) in 2,500 hours
Ni-Hard	103
Steel	182–202

Table IV

Since this new type of ball is marketed at a moderate price the first and most obvious advantage accruing to the paint manufacturer is a reduction in grinding media costs. But a second and far more important advantage is that the martensitic white iron ball—through its very low wear rate--permits the grinding of pastel pigments which heretofore had to be ground with porcelain balls or flint pebbles to prevent discoloration. The replacement of a low density grinding media with one having the density of white iron 7.7 g./cc. offers some very attractive possibilities in reducing the time required to accomplish the necessary grinding or mixing.

To go one step further, consideration is being given to using martensitic white iron for the mill liner as well as the ball charge in order to achieve minimum discoloration. Mill liners of this material could be cast in block form and cemented in place in the mill in much the same manner as porcelain blocks are installed.

Based upon years spent in following the progress of the martensitic white irons as they have found their place of usefulness in various industrial fields it is safe to predict that balls and mill liners of this material will establish a new level of efficiency and performance in the field of paint manufacturing.

Formulate your Aluminum Paint
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and provide these 3 big advantages to your petroleum industry customers—
• LOWER EVAPORATION LOSS —It reflects heat to a higher degree than standard paste pigments.
• LESS FREQUENT PAINTING —Due to its greater degree of whiteness, color change is at a much lower rate—resulting in reduced maintenance costs.
• IMPROVED APPEARANCE — It produces a whiter, brighter finish with a minimum of highlighting and spotty glare.
These and other advantages of this unique aluminum pigment are of unusual interest to all users of aluminum paint. They are of particular advantage to the petroleum industry.
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Lacquer for Cellulose Propionate

U. S. Patent 2,510,166. Alan P. Baruch, Newark, and Ralph E. Porzer, Bloomfield, N. J., assignors to Celanese Corporation of America, a corporation of Delaware.

Cellulose propionate materials coated with a firmly-adherent, blush-resistant coating deposited from a lacquer consisting essentially of 100 parts by weight of cellulose nitrate dissolved in 350 to 800 parts by weight of a medium boiling volatile solvent for the cellulose nitrate, 350 to 800 parts by weight of a lower aliphatic alcohol diluent having at most five carbon atoms which is a latent solvent for the cellulose nitrate and 300 to 650 parts by weight of a non-solvent aliphatic petroleum hydrocarbon diluent.

Protective Coating

U. S. Patent 2,507,239. Lester Aronberg, Chicago, Illinois.

A protective coating composition, having good surface adherence characteristics and being resistant to elevated temperatures, comprising, in admixture, an organic film-forming material and anhydrous lead metaborate, the amount of lead metaborate exceeding that of the organic film-forming material the said relatively high proportion of lead metaborate functioning to form in itself substantially a continuous bond and protective film, when the coating comprising the same has been subjected to a sufficiently high temperature to volatilize and carbonize the film-forming material.

Water Paste Paints

U. S. Patent 2,511,782. Betty O. Newman, Schenectady, N. Y., assignor to National Gypsum Company, Buffalo, N. Y., a corporation of Delaware.

A non-flashing water thinnable casein paste paint consisting essentially of peptized casein, pigments, fillers, water and from about 1 to 5% by weight of a sugar derivative selected from a group consisting of gluconic, carbonic, mannonic, gulonic, galactonic and talonic acids.

Pigment Dispersion in Ethylene Polymers

U. S. Patent 2,512,459. George Erving Hamilton, Parkersburg, W. Va., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware.

Process of uniformly pigmenting tough, solid ethylene homopolymer which comprises mechanically working in the absence of liquid diluents and out of contact with said ethylene polymer in the fused state, a finely-divided, difficulty dispersible pigment and a hydrocarbon wax having a melting point of 120° F.–200° F., the proportion of wax to pigment being at least 1:1, at a temperature above the melting point of said wax until said pigment is uniformly dispersed in said wax, and thereafter mixing the pigment dispersion in wax with said ethylene polymer in the fused state until a composition substantially free of pigment agglomerates is obtained.

Antioxidants

U. S. Patent 2,511,428. Loran Oid Buxton, Maplewood, and Charles Early Dryden, East Orange, N. J., assignors to Nopco Chemical Company, Harrison, N. J., a corporation of New Jersey.

A process for enhancing the antioxidant activity of a phosphatide which comprises heating in contact with ammonia a mixture of a phosphatide and a volatile organic solvent in which the phosphatide is at least partially soluble, said solvent having a boiling point of at least about 40° C., the heating being carried out at about the reflux temperature of the solvent, and thereafter removing from the phosphatide the free ammonia admixed therewith, the ammonia combined with the fatty acids in the phosphatide, the volatile organic solvent and any water which is present in the mixture, said removal of the ammonia, the water and the solvent being accomplished by heating the phosphatide under reduced pressure until the ammonium soaps therein are split into free ammonia and free fatty acids and the ammonia is removed from the phosphatide leaving the free fatty acids in the phosphatide.

Polyvinyl Acetate Emulsions

U. S. Patent 2,510,257. William D. Robinson, Niagara Falls, N. Y., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware.

An aqueous polyvinyl acetate emulsion containing at least 30% by weight of water, water-soluable polyvinyl alcohol in sufficient amount to function as an emulsifying agent, and 0.1% to 1.0%, based on the weight of total solids in the emulsion, of glyoxal.

Lacquer for Polystyrene

U. S. Patent 2,510,851. Kenneth D. Bacon and Arthur E. Young, Midland, Mich., assignors to The Dow Chemical Company, Midland, Mich., a corporation of Delaware.

A lacquer composition, particularly adapted to coating surfaces of polystyrene, comprising one part by weight of ethyl cellulose having an ethoxyl content of 44.5 to 49.5 per cent and 0.6 to 1.7 parts of a phenol-modified coumarone-indene resin as the essential film-forming ingredients dissolved in a solvent therefore of which more than 85 per cent by weight is a material boiling between 75° and 140° C. and composed of at least one substance of the group consisting of alcohols and ether-alcohols, such solvent containing not more than 10 per cent of a hydrocarbon.

Nitrocellulose Emulsions

U. S. Patent 2,510,834. Herman C. Phillips, Wilmington, Del., assignor to Hercules Powder Company, Wilmington, Del., a corporation of Delaware.

The process of preparing a lacquer-in-water emulsion which comprises agitating a water slurry comprising nitrocellulose, sufficient water to form a slurry and a water-soluble emulsifying agent with a water-immiscible volatile nitrocellulose solvent to substantially completely colloid the nitrocellulose and to form a rough lacquer-in-water emulsion, and homogenizing said rough emulsion to form a stable emulsion.

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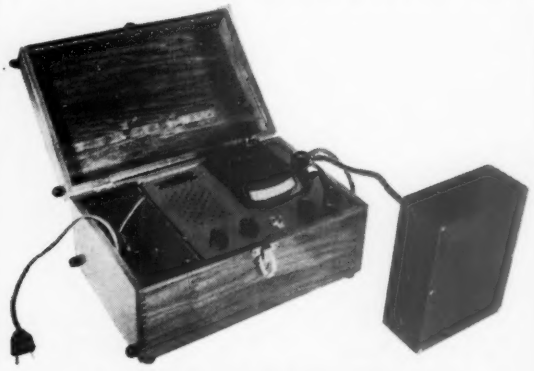

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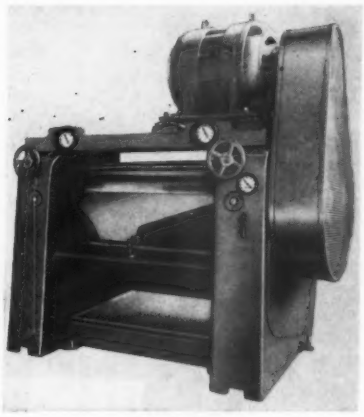


J. M. Lehmann

PAINT MILLS
Sight-O-Matic Control

High production 3 roll and 5 roll mills are equipped with Sight-O-Matic Control which reduces the human element and saves time in roll setting. Gauges at each end of the slow and fast rolls enable the operator to visualize the effects of adjusting the handwheel. According to the manufacturer, this provides the means for equalizing the pressure, thereby maintaining uniformity of grind along the entire face of the roll. These mills also feature a pneumatic discharge control which afford improved regulation and uniformity blade pressure across the face of the roll. A dial indicating thermometer on the water inlet manifold and dial thermometer at each of the roll water outlets, indicates the temperature of the discharge water from each roll. J. M. Lehmann Co., Inc., Lyndhurst, N. J. PVP—September.

STANDARD REAGENT
For C-H-O Analysis

Citraconic anhydride is used as a standard for carbon-hydrogen-oxygen determination using the combustion method. Smith-New York Co., Freeport, Long Island, N. Y. PVP—September.

STABILIZERS
For Vinyls

Called "Dutch Boy" Plumb-O-Sil "C" and Plumb-O-Sil "D," these stabilizers are co-precipitates of lead orthosilicate and silica gel and are characterized by easy dispersion in vinyl plastic products. Used primarily in translucent compounds, they impart heat and light stability to vinyl plastics, especially those with vivid colors and of deep shades. National Lead Co., 111 Broadway, New York 6, N. Y. PVP—September.

TACHOMETER GENERATOR
For Hazardous Locations

The new Type E tachometer generator has been specifically designed for use where there may be explosive atmospheres. Available as either an a-c or a d-c generator, this type is listed by Underwriters' Laboratories, Inc., for use in two classes of hazardous locations: Class I, Group D (flammable and explosive mixtures of vapors and gases with air); and Class II, Groups F and G (combustible mineral and grain dusts in air). Its construction makes it particularly suitable for use in oil refineries, chemical plants, and similar locations where explosive atmospheres may occur. Weston Electrical Instrument Corp., 617 Frelinghuysen Ave., Newark 5, N. J. PVP—September.

KNEADING MACHINE
Double Arm Type

Mixing and kneading machines with improved designs offer new advantages in floor space requirements. Tiltable models have working capacities nearly double that of lighter duty machines. Heavy duty models include intensive type internal mixer for masticating rubber stocks, resin paints, plastics and floor coverings. H. W. North Co., 1213 Parade St., Erie, Pa. PVP—September.

SKIP TOTE BOX
Used with Fork Truck

Skip tote box, with trunnions is designed for convenient handling for fork truck or crane. Boxes are built to any size required, and load capacity and color of paint may be specified. Palmer-Shile Co., 16039 Fullerton, Detroit 27, Mich. PVP—September.

CASTERS
Heavy Duty

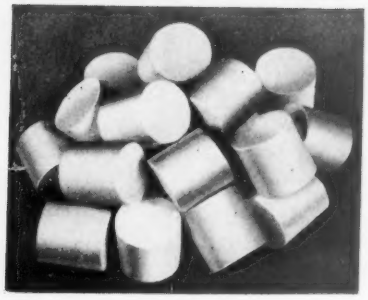
These low-cost, practically indestructible 500 Series casters are designed for heavy-duty service on racks, dollies, and portable equipment in many industries. Rapids-Standard Co., Inc., Grand Rapids, Mich. PVP—September.

CELLULOSE TAPE
With Safety Markings

Cellulose tape, printed in vivid colors with the words "Poison," "Corrosive" and "Flammable" is available in convenient roll form with a heavy cast dispenser. The tape is recommended as a safety precaution for marking all reagent bottles, packages, etc., that are handled by individual workers. Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa. PVP—September.

Fisher Scientific

NEW PRODUCTS



U. S. Stoneware

BALL MILL MEDIA

Non-metallic

"Borundum," a new non-metallic ball mill grinding medium, is heavy, hard and tough, resembling synthetic sapphire in composition, according to the manufacturer.

In ball milling, weight, hardness, shape and size of grinding media are principal factors affecting grinding speed. Toughness and wear-resistance are major factors in limiting mill charge contamination from media "wear-off."

"Borundum" Grinding Media weigh 75–80% more and are up to 50% harder, than conventional media. Their unique tubular shape is said to provide greater contact area. Their relatively smaller size (13/16" O.D. by 13/16" long) was selected after lengthy tests as the most effective for both large and small capacity mills. The U. S. Stoneware Co., Akron, Ohio. PVP—September.

GLYCERYL RICINOLEATE

Improves Pigmented Latices

Better flow-out and greater uniformity and covering power is obtained with organic pigments in polymer latices by the use of glyceryl (mono) ricinoleate S. According to the manufacturer, good results have been obtained with many copolymer latices including vinyls, styrene, and acrylates. This material is compatible with all the usual latices and plasticizers, and tends to act as a stabilizer in these products. About 1% of glyceryl (mono) ricinoleate S, based on the weight of the dry pigment is used. Samples of this material may be obtained from Glyco Products Co., Inc., 26 Court St., Brooklyn, N. Y. PVP—September.

STATIC CONTROL

For Solvent Vapors

Called the TAKK Static Control, this equipment is used to control the hazard due to static where highly volatile solvents are present. The equipment is being used successfully in vapors of isopropyl acetate, acetone, methyl ethyl ketone, or toluol. It has also been tested in explosive concentrations of ether, naphtha, benzine and carbon disulphide.

According to the manufacturer, this equipment will control static on any type of material and on most type of machines, even at speeds in excess of 2,000 feet per minute. For further information write to the John Hewson Co., 106 Water St., New York, N. Y. PVP—September.

TERPENE PHENOLIC

For Wrinkle Finishes

"Durez 220," a terpene phenolic is said to be particularly good as a basic ingredient in the manufacture of wrinkle finishes of uniform patterns over a variation of film thickness. Durez Plastics & Chemicals, Inc., N. Tonawanda, N. Y. PVP—September.

FLUSHED BLUES

Permanent Types

Two new permanent flushed blue pigments are available in regular linseed varnish concentrations. Hilton-Davis Chemical Co., Cincinnati, Ohio. PVP—September.

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Now 7¢ per pound
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Specifications

COLOR BARRETT	7
SOFTENING POINT °F.	200-220
IODINE NUMBER	180 min.
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Plant Texas City, Texas

NEW PRODUCTS

ALKYD RESIN

Fast-drying, oil-soluble

"Modiphat 345," a new varnish alkyd resin is fast drying and oil-soluble. It is made with fatty acid mixtures containing substantial amounts of conjugated linoleic acid. When heated slightly, it disperses rapidly in oil, producing rapid-drying varnishes which yield hard, tough films with excellent color and resistance to water and alkali. General Mills Research Laboratories, Minneapolis, Minn. PVP—September.

DEFOAMER

Brick Form

Defoamer in convenient form, 2½-lb. bricks, is now commercially available. Called Defoamer 4, the new product offers several outstanding advantages in handling and use, according to the manufacturer. These advantages include: excellent defoaming efficiency, small storage space, no drums to handle, one brick makes a batch, stable dilute emulsions. Hercules Powder Co., Wilmington, Del. PVP—September.

LATEX COPOLYMER

Low-cost

Known as Dow Latex 744, a copolymer of vinyl chloride and vinylidene chloride, this material is said to have application in paper coatings, textile coatings, paints, etc. According to the manufacturer, this copolymer has excellent heat and light stability, wide compatibility and good storage stability. Plastic Sales Div., Dow Chemical Co., Midland, Mich. PVP—September.

ANTI-FLOODING AGENT

For Colored Enamels

Raybo 3 is an anti-silking and anti-flooding agent for colored enamels. It prevents or retards the tendency of colored enamels to show hair line striations and mottled effect of floating pigment agglomerates. According to the manufacturer, this material when used, does not detract from gloss, drying, or brushing properties of the enamel. Raybo Chemical Co., 929 Penn Ave., Pittsburgh 22, Pa. PVP—September.

ISOPROPYL BENZOATE

For Manufacturing Alkyds

Isopropyl benzoate is now being manufactured for the first time in major commercial quantities by Carbide and Carbon Chemicals Division, Union Carbide and Carbon Corporation.

Isopropyl benzoate is a water-white liquid and by ester exchange is a source of benzoic acid. Therefore, it is of particular interest as a raw material for alkyd resins. Isopropyl benzoate reduces the viscosity during the intermediate stages of the "cook," dissolves easily, and reacts rapidly with available hydroxyl groups of other alcohols and glycols which are raw materials for resins. It is easier to produce high-boiling esters with isopropyl benzoate than with the free acid because it reacts more rapidly and the reaction product is not water but isopropanol, which leaves the system more easily.

Isopropyl benzoate is a high-boiling (218.5° C.) solvent for many materials including inks and dyes. Its pleasant aromatic odor can be used to build desirable odors in certain industrial products and to mask undesirable ones in others. Carbide and Carbon Chemicals Div., Union Carbide and Carbon Corp., 30E 42nd St., New York 17, N. Y. PVP—September.

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In a big beneficial way—DRIERS *are our Business*

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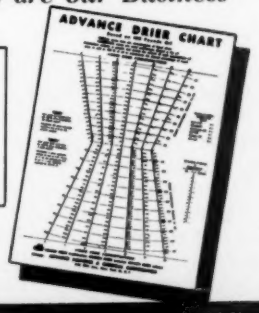

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George W. Gregg

Gregg Joins Technical Service Div. of Advance Solvents

A. B. Mullaly has announced the appointment of George W. Gregg as assistant to Mr. C. A. Klebsattel, head of the Technical Service Div. of Advance Solvents & Chemical Corp. Mr. Gregg is well known in the paint and varnish industry.

•

Reichhold Acquires Plant In Chicago Area

Reichhold Chemicals, Inc., Detroit, Mich., has purchased plant and property at 7738 W. 61st Place, Argo, Ill. The company stated that the acquired buildings which provide 150,000 sq. ft. of floor space will undergo immediate renovation. A full line of synthetic resins and a complete range of inorganic and organic pigments will be produced at this new plant.

•

Plasticizer Production Begins At New Pittsburgh Coke Plant

Commercial production of a new line of synthetic organic chemicals, consisting of a variety of plasticizers used in compounding resins, rubber, and paint is now underway at the new plasticizer plant of Pittsburgh Coke & Chemical Co., Neville Island.

The new plant is producing plasticizers that are essentially odor-free, water-white, and acid-free and of constant physical and chemical properties. A new fully equipped laboratory has been set up to handle plasticizer sales service problems, as well as to permit the thorough evaluation and testing of new plasticizers developed by the research department.

Douglas C. Carruthers of Pittsburgh Plate Dies

Douglas C. Carruthers, general manager of Pittsburgh Plate Glass Company's paint plant at Springdale, Pennsylvania, died recently of a heart ailment.

A native of Plymouth, Michigan and a graduate of Michigan State College, Mr. Carruthers had been associated with the firm's Ditzler Color Division at Detroit prior to World War II. Discharged with the rank of Colonel after five years service in South Pacific areas, Mr. Carruthers returned to Pittsburgh Plate's paint plant at Milwaukee. He was appointed general manager of the ultra-modern plant at Springdale when that facility went into production during 1947.

Second Plant Maintenance Show

The Plant Maintenance Show, which drew industrial executives from 35 states and many foreign countries when it was conducted for the first time early this year, will be held again at the Auditorium, in Cleveland, O., Jan. 15–18, inclusive.

Advance registration cards and hotel information may be obtained from Clapp & Poliak, Inc., 341 Madison Avenue, New York 17, N. Y.

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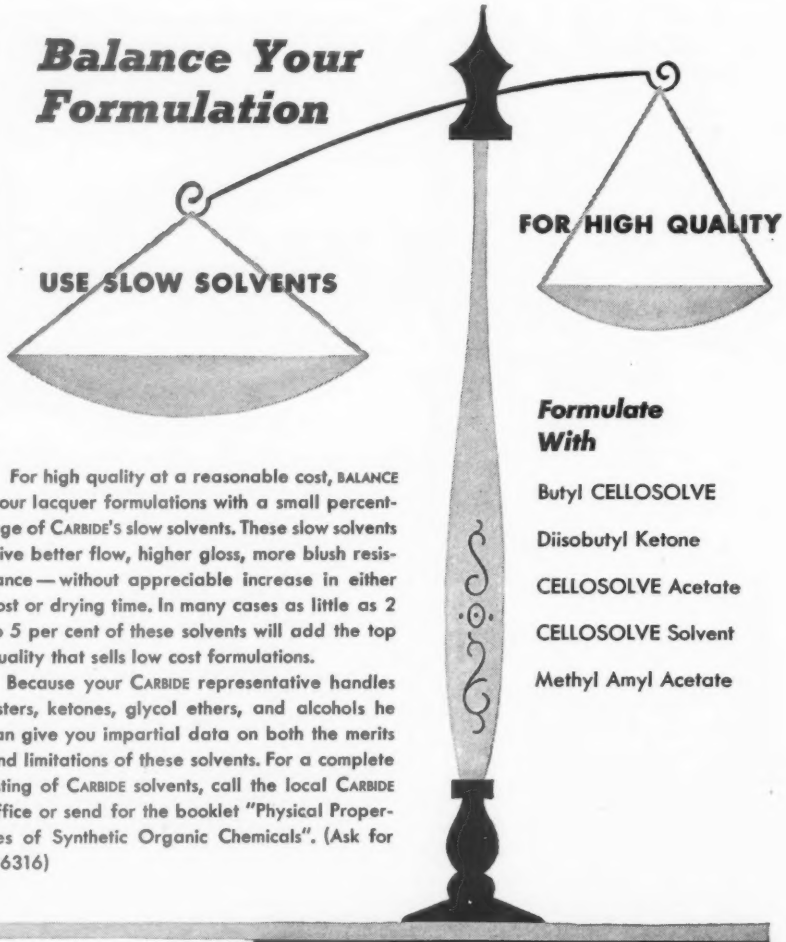
PPG Names West Coast Technical Director

Frank H. Martin has been named technical director of Los Angeles Paint Division, Pittsburgh Plate Glass Co. Mr. Martin will be responsible for West Coast technical activities.

Balance Your Formulation



For high quality at a reasonable cost, BALANCE your lacquer formulations with a small percentage of CARBIDE'S slow solvents. These slow solvents give better flow, higher gloss, more blush resistance — without appreciable increase in either cost or drying time. In many cases as little as 2 to 5 per cent of these solvents will add the top quality that sells low cost formulations.

Because your CARBIDE representative handles esters, ketones, glycol ethers, and alcohols he can give you impartial data on both the merits and limitations of these solvents. For a complete listing of CARBIDE solvents, call the local CARBIDE office or send for the booklet "Physical Properties of Synthetic Organic Chemicals". (Ask for F-6316)

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Butyl CELLOSOLVE

Diisobutyl Ketone

CELLOSOLVE Acetate

CELLOSOLVE Solvent

Methyl Amyl Acetate

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Surface Technology Course Offered at NYU

In response to continuing demand, the Department of Chemical Engineering will again offer a series of graduate courses in Surface Technology, they are:

Ch.E. 174–175. Surface Finishes. Prerequisite: Ch.E. 71, 81, or equivalent. Adjunct Associate Professor Kronstein. Full course, first and second terms. Wednesday, 7:00–9:05 P.M.

A study of the principles involved in protective, decorative, and functional finishing. Economic factors. Forms of finishing problems. Types of surfaces, types of finishes, methods of application. Specifications, test methods. Research, production, and control methods. Advanced finishing problems.

Ch.E. 176–179. Surface Finishes Laboratory. Prerequisite: Ch.E. 174 or 175. Adjunct Associate Professor Kronstein. Full course, first and second terms. Friday, 7:00–10:00 P.M. (May be taken simultaneously with Ch.E. 174–175.)

A laboratory introduction to the basic processes of decorative and protective finishing.

Ch.E. 301–302. Research. Adjunct Associate Professor Kronstein. Properly qualified students may pursue experimental studies in connection with the preparation of theses.

The registration dates for these courses are as follows:

First term: Tuesday, September 12 through Friday, September 15, 1950.

Second term: Wednesday, January 24 through Friday, January 26, 1951.

Registration is held at South Hall, University Heights campus, 181 Street and University Avenue, Bronx, New York, from 6:30 to 8:30 P. M.

•

Paint and Resin Courses At Brooklyn Polytechnic

Courses to be offered at Brooklyn Polytechnic during 1950–1951 when the fall semester opens September 25th include:

"Oil, Resin and Varnish Technology," "Technology of Resins and Plastics," and "Paint and Pigment Technology." The course in the series which will be given in 1951–1952 are the "Technology of Organic Coatings," "Protective and Decorative Coatings for Metal," "Oil, Varnish and Resin Technology," and "Paint and Pigment Technology."

Protective Coating Committee of Corrosion Engineers Organized

Protective Coating Technical Practice Committee No. 6 of the National Association of Corrosion Engineers has organized its activities on the West Coast by appointment of L. L. Whiteneck, Senior Harbor Engineer, Board of Harbor Commissioners, Long Beach, California as its West Coast co-ordinator.

Mr. Whiteneck reports active response at the organization meeting held in Los Angeles on April 26th with considerable interest shown in the committee activities on protective coatings for atmospheric, marine, and petroleum exposures and surface preparation for protective coatings. The use of metallic as well as organic coatings proved of interest to this committee division.

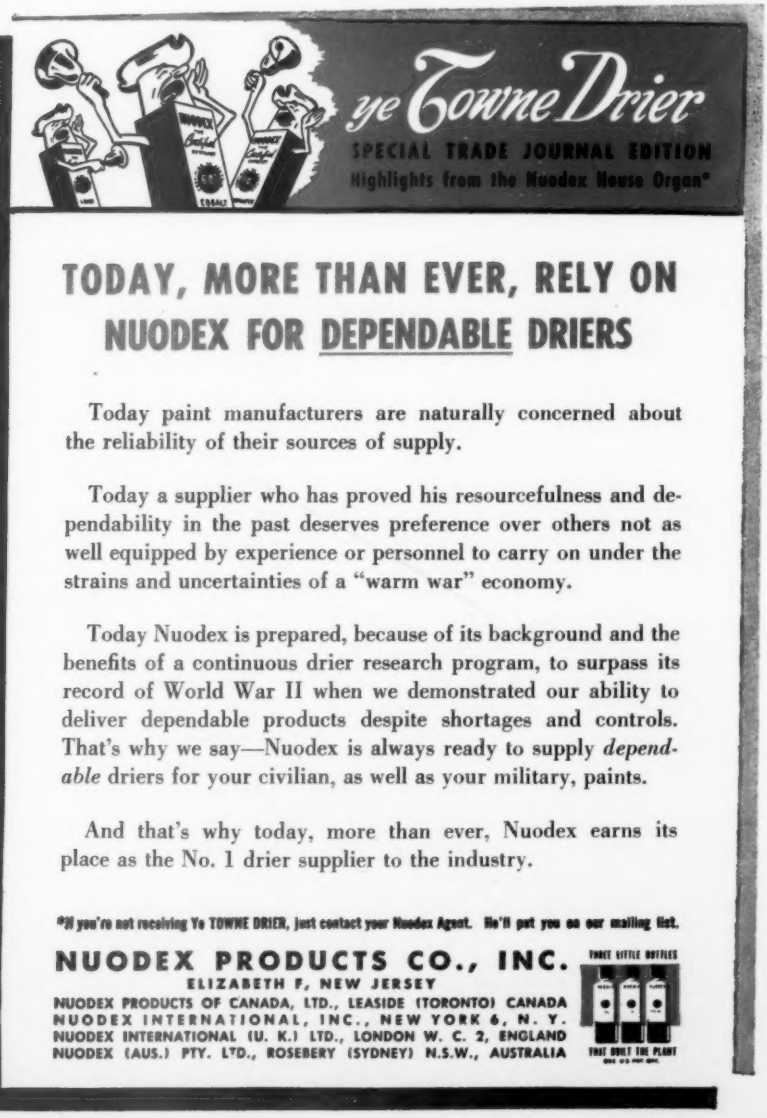
Atlas Powder to Increase Sorbitol Output by 50%

Expansion of the sorbitol plant capacity at Atlas Point, Wilmington, Del., was announced recently by Atlas Powder Co. Capacity of the sorbitol units will be increased by 50% and the increased production will begin about October first.

•

Barrett Named Head of GE Plastics Division

Willard R. Barrett, formerly vice president and general manager of the Hoosier Cardinal Corporation of Evansville, Indiana, has been named sales manager for the Plastics Division of the General Electric Company, according to an announcement by Herbert M. Brusman, division manager.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SPECIAL TRADE JOURNAL EDITION
Highlights from the Nuodex House Organ*
TODAY, MORE THAN EVER, RELY ON
NUODEX FOR DEPENDABLE DRIERS
Today paint manufacturers are naturally concerned about the reliability of their sources of supply.
Today a supplier who has proved his resourcefulness and dependability in the past deserves preference over others not as well equipped by experience or personnel to carry on under the strains and uncertainties of a "warm war" economy.
Today Nuodex is prepared, because of its background and the benefits of a continuous drier research program, to surpass its record of World War II when we demonstrated our ability to deliver dependable products despite shortages and controls. That's why we say—Nuodex is always ready to supply dependable driers for your civilian, as well as your military, paints.
And that's why today, more than ever, Nuodex earns its place as the No. 1 drier supplier to the industry.
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THAT LITTLE BOTTLE
THAT BUILT THE PLANT

TECHNICAL Bulletins

ZINC OXIDES

Fifty-five page book is a complete and informative manual on lead-free zinc oxide. The book is divided into two parts. Section I is concerned with the production of lead-free zinc oxide and Section II contains technical data on various grades of red, black and green label zinc oxides. Of special interest to the paint manufacturers, there is information on the use of zinc oxides in protective coatings. Photomicrographs and charts analyzing particle size distributions together with physical and chemical properties of this pigment are also included. A brief discussion on the role of zinc oxide in the major consuming industries are also given. Copies of this booklet may be obtained by request on company letterhead. St. Joseph Lead Co., 250 Park Ave., New York 17, N. Y.

DISPERSERS

Homogenizers and dispersers applicable to numerous products are described in this booklet. Data and photographs cover laboratory and research models of these machines which are used for dispersing pigments and solids, and the production of all types of emulsions with or without pigments. Tri-Homo Corp., Salem, Mass.

VINYL ORGANOSOLS

Technical bulletin, No. 139, gives general composition, formulation, and description of black vinyl organosols. Binney & Smith Co., 41 E. 42nd St., New York 17, N. Y.

FATTY ACIDS

Complete information on specification, characteristics such as stability, composition, high quality, uniformity of solid fatty acids, their effect on finished products utilizing fatty acids is included in the bulletin. Factors such as processing methods and packaging are also covered by the comprehensive report. Emery Industries, Inc., Cincinnati, Ohio.

EMULSION STABILIZER

Technical Bulletin 5-49 describes the use of "Teac-90" as an emulsion stabilizer, anti-oxidant, and solubilizer in emulsion paints, latex, and gum solutions. General characteristics such as compatibilities and detailed information on the use of this material in various emulsions are also included. Process Chemical Specialties, P. O. Box 345, Beverly, Mass.

MIXERS

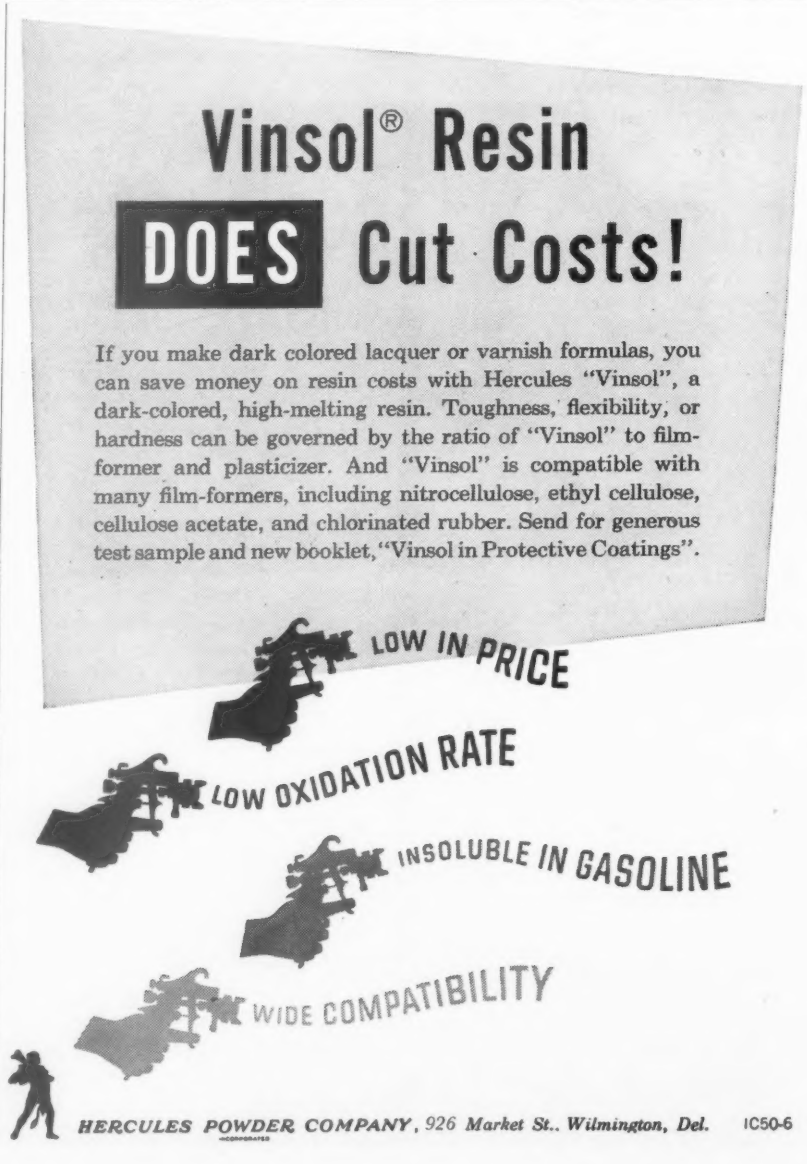
Bulletin No. 260 lists various types of grinding and mixing equipment. General descriptions, photographs, dimensions, and speed unit charts are included. U. S. Stoneware Co., Akron, Ohio.

SAVING EQUIPMENT

All types of labor and material saving equipment including automatic fillers, tumblers, drum cleaners, chain elevators for drums, drum tippers, drain racks, drum painter, etc., are included in an eight-page folder published by the Vol-U-Meter Co., Buffalo 16, N. Y.

DRUM WARMER

Folder describes automatic drum warmer for use with metal drums. This unit may be used to warm anything up to 400 degrees F. Construction, uses and prices are included. Harold L. Palmer Co., 6432 Cass Ave., Detroit 2, Mich.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DOES Cut Costs!
If you make dark colored lacquer or varnish formulas, you can save money on resin costs with Hercules "Vinsol", a dark-colored, high-melting resin. Toughness, flexibility, or hardness can be governed by the ratio of "Vinsol" to film-former and plasticizer. And "Vinsol" is compatible with many film-formers, including nitrocellulose, ethyl cellulose, cellulose acetate, and chlorinated rubber. Send for generous test sample and new booklet, "Vinsol in Protective Coatings".
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CAN LABELING

Successful Can Labeling is the title of a 22-page booklet which contains detailed information on can labeling. Operational data discussed are such factors as labeling by hand and machine, adhesives, and selection of labels. Labeling difficulties—their causes and corrections are neatly tabulated. Can temperatures and cold pick-up gums are also discussed. National Adhesives, 270 Madison Ave., New York, N. Y.

SYNTHETIC RESIN

The latest German patent applications in the field of synthetic resins are now offered in translated form by Research Information Service, 509 Fifth Avenue, New York 17, N. Y. in their Special Research Bulletin No. 47, which supplements the previously issued Bulletin No. 44 "Plastics".

The new bulletin features a wartime patent describing the preparation and novel applications of the compound dimethane sulfonylimide, which has attracted considerable interest since first mentioned in a Research Information Service report as a hardening agent for phenol-formaldehyde resins characterized by exceptional stabilizing action.

In addition, a number of post-war patent applications from Germany, all filed within the last 3 years, are listed. These include the invention of "A New and Superior Plastic Material from Organisilic and Inorganic Compounds" by E. Leitz, Wetzlar (Report No. 5955, $8.75), a process for obtaining bitumen or resin emulsions of extremely fine dispersion and high stability, developed by Badische Anilin-Soda-Fabrik (formerly I. G. Farbenindustrie) (Report No. 5956, $6.50), several innovations in the production and processing of polyvinyl chloride and polystyrene, as well as other processes.

FLEXIBLE VALVES

The Flexible Valve Corporation, 621 Comercial Ave., Palisades Park, N. J., offers a 16-page catalog giving complete data on their line of natural and synthetic rubber (Neoprene-Buna N-Buna S-Butyl) pinch type Flex-Valves. Performance charts, photographs, and schematic drawings are included.

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VALVES

Reducing valves are discussed in a 24-page bulletin released by the Kilpfel Mfg. Co., 1000 Weller Ave., Hamilton, Ohio. Such important factors as operation, construction, prices, capacity data and weights are provided.

TENN. EASTMAN CATALOG

Tennessee Eastman Corp. of Kingsport, Tenn. has recently published a new edition of its catalog entitled "Eastman Industrial Chemicals." The new edition covers a description of all the chemicals offered by this firm including specifications, properties and uses.

PARADICHLOROBENZENE

Eight-page bulletin describes laboratory and field studies of paradichlorobenzene as volatile fungistat. Properties, specifications, summary of previous work, uses and recommendations are also given. Issued by the Monsanto Chemical Co., St. Louis, Mo.

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abstracts

New Theory on Structure of Phenol-formaldehyde Resins

Dr. H. Lück. Presented at the First General Meeting of the Paint and Varnish Committee of the Chamber of Technology, Berlin.

The phenol-formaldehyde condensates are mixed aromatic aliphatic series of molecules of special structures, of which the Novo-lacquers are less complicated than the Resoles, whose intermediate chains may suffer very differentiated transformations. The common theory regarding the hardening effect heretofore was that this is due to irregular combinations of free reactive agents.

However, it was found that this process really represents a reaction, or transformation, which while quite modifiable finally leads to the formation of regular molecule aggregates. A finding of considerable importance was the recognition of the fact that the hardening transaction proceeds over an inner-molecular cyclization, which is rendered possible by the ethin- or ethylene groups characteristic of the resoles. These reactions led to the xanthene, chromane and phenanthrene complexes as well as to other large molecular complexes causing the densification of the molecular structures to hydrocarbon structures.

These transformations led up to the natural assumption that the arrangement of the individual phenol groups within the molecule series must also be of a very particular character, especially in view of the fact that all phenol compounds exhibit identical processes of reaction during condensation. This observation was more remarkable in view of the considerable difference between the number of functional points within the phenol structure as well as between the number of their methyl groups and the relative position of the valencies in adjacent diametrical arrangements within their ortho-meta-para position.

The deviations of the resinous properties of the individual compounds are therefore induced in the first place by the number of their functional groups and their substituents, while the addition of the aldehydes represents a function of all phenol compounds.

This proves that the phenol molecules must be arrayed in an alternate sort of arrangement, i.e. a serpentine form, toward each other. The chain molecules must therefore exhibit a sinuous (spiral) structure (Meyson).

If this structural arrangement is assumed to exist, it is quite obvious that completely identical molecule complexes are formed, whose behaviour and reactions can be explained in all details.

These structures also promise the realization of certain properties of synthetic resins which should be of pronounced technical advantage. It was possible, for instance, to coincide these properties of the oxynaphthylin resins with their structures. Since in a number of instances these compounds are 4-functional phenols, such as pyrocatechin (orthodioxy-benzene) and hydroquinone (paradioxy-benzene) it was possible to form structures of particularly well hardenable compounds containing large groups of molecules and promising particularly high degrees of heat resistance.

However, the most interesting structural transformations were encountered in studying the intermediate chain reactions of the phenol-resoles obtained by decomposition of the ethine, ethylene and methylene carbinol groups, which led to the production of chinomethides, oxaldehydes, chromanes or phenylized cumarons, or of phenanthrene and xanthene complexes.

There were numerous splitting (decomposition) and hardening reactions, many of which were but difficultly determined on account of the rapid decomposition of these fractions and of their high degree of reactivity, but it was possible to determine a considerable portion of the course of reactions by comparison with model substances containing no hydroxyl groups. Attention should in this connection be called to the scientific studies and publications of *Euler, Zincke, Ziegler, Hultsch, Hanus* and their cooperators. Based on their results and our observations it can be generally stated that the formation of reactive groups of the intermediate chains induces nettings of a specific type which in cooperation with the hydroxy-groups induce the strengthening of the structure in the formation of resite. Methylated phenols are thus further improved by the activity of the methyl groups.

Attention should be called to the fact that netted condensates do not always increase the degree of hardness of the resin resites in question; there are elastic resites of the highly methylated phenols, whose properties would permit many kinds of technical application, apart from the paint and varnish industries themselves. Indeed it would even be possible with these products to manufacture flexible wood fibre—synthetic resin plates.

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It should now be possible by widening the range of transformation possibilities to attain particularly important developments of valuable synthetic resins. This applies especially to reactions of the phenol compounds with di-isocyanates which by interaction with the hydroxyl groups permit the development of an entirely new construction of synthetic resins, implying furthermore the formation of stable intermediate chains with particular netting properties.

Structurally interesting were these condensates on account of their hardening reactions leading over urethane to combined phenylimin chains and furthermore to phenylized amido compounds characterized by the properties of ester resins and aromatic amino-resins.

It was also found possible to obtain modification reaction without much difficulty, enabling the development of a large number of synthetic resins from the most impossible compounds. This applies particularly to the tar-distillation products such as the xylenols, cumenols, aromatic amines, imines, etc.

The discussion of this paper proved the highly critical attitude of some of the specialists within the audience. Especially Dr. Ehlers and Dr. Leibnitz pointed out that many of the reactions indicated could actually be effected but that for technical purposes they really were of minor importance. Dr. Ehlers also called attention to the fact that the phenolate ion reacts only in the case of alkaline condensation processes.

New Methods for Determining Varnish Raw Materials

Dr. C. Gordijenko (German Academy of Sciences). Presented at the First General Meeting of the Paint and Varnish Committee of the Chamber of Technology, Berlin.

Present analytical and other scientific methods for determining more than 300 synthetic resins employed in varnish and lacquer manufacture permit an exact determination of 15 to 20 groups, but are unable to recognize every individual resin. It is thus evident that every group of synthetic resins averages about 20 individual resins of different properties.

All these methods of determination—or group determination—are based on the well-known processes of determination of the constitution of organic substances.

Dr. Gordijenko is of the opinion that these methods are too tedious and inaccurate for the purposes in question and suggests the adoption of entirely new modes of approach:—Description of the constitution instead of the determination of the constitution employed up to the present time.

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COLOR (G-H)	2+	10
NEUTRALIZATION VALUE	193	180
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APPLICATIONS

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The description of constitution requires the determination of the most characteristic and—at the same time—most easily determined properties of the synthetic resins. These include:

a) Precipitation reactions similar to those employed in organic analysis with the aid of solutions containing the characteristic functional groups—commencing with the hydrocarbons down to the most polar alcohols and organic acids.

b) the optic and chemical properties:—Refraction index, specific refraction

$$\frac{n^2 - 1}{n^2 + 2} \times \frac{1}{d}$$

drum index (from which the degree of dispersion is calculated), qualitative organic analysis, etc.

This method of determining individual synthetic resins has been applied to about 1000 substances (tests), half of them macromolecular substances, the other half liquid (fluid) substances. Since in all these tests, the above indicated methods of determinations has proved highly satisfactory, Dr. Gordijenko recommends its application to other fields of the macro-molecules as well, especially for the albumins and other physiologically important substances.

During the discussion of this paper, Dr. Thinius of the Deutsche Hydrierwerke, Rodleben, pointed out that it was easy to distinguish between nitrocellulose made from cotton waste and from wood cellulose by means of the "clouding titration" with benzene.

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Colorimetry

By Deane B. Judd. Published by U. S. Government Printing Office, Washington 25, D. C. Request Circular C478. Price, 30 cents.

Colorimetry is of vital importance in modern mass-production methods. Only through the use of a grading system based on determination of color can the textile manufacturer produce goods of uniform color at a price low enough to sell. Likewise, the assembly of a complicated machine like a refrigerator often requires a color specification for each of several parts. For the past 20 years, the National Bureau of Standards has played a leading part in establishing practical working standards of color and in setting up and administering color tolerances. As a result, conformity to a color requirement can now be determined with the same assurance as mechanical properties. The present booklet describes the standards and measurement methods developed by the Bureau in this field, giving the basis for each technique and showing clearly how one method supplements the other. Chapters cover the following topics: the standard observer; illuminants and coordinate system; small-difference colorimetry; material standards of color; one-dimensional color scales; and general methods.

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CALENDAR OF EVENTS

Sept. 18–22. National Instrument Conference and Exposition, Buffalo, N. Y.

Sept. 26–28. American Oil Chemist Society, Sir Francis Drake Hotel, San Francisco, Calif.

Sept. 26–29. Industrial Packaging & Materials Handling Exposition, Philadelphia, Pa.

Oct. 16–20. National Safety Congress, Chicago, Ill.

Oct. 18–20. Society of the Plastics Industry, New Ocean House, Swampscott, Mass.

Oct. 23–25. Packaging Institute, Annual Forum, Commodore Hotel, New York, N. Y.

Nov. 9–11. Federation of Paint and Varnish Production Clubs Convention, Congress Hotel, Chicago, Ill.

Nov. 15–18. National Paint, Varnish and Lacquer Association Convention, Fairmont Hotel, San Francisco, Calif.

Nov. 18. Third annual paint and varnish chemistry symposium, New York University, College of Engineering, Bronx 53, N. Y.

Jan. 18–20. Society of Plastics Engineers, National Technical Conference, Statler Hotel, N. Y.

Mar. 5–9, 1951. A.S.T.M., Committee Week and Spring Meeting, Netherland Plaza Hotel, Cincinnati, Ohio.

Mar. 7–9. Southern Paint, and Varnish Production Club Meeting. Buena Vista Hotel, Biloxi, Miss.

Mar. 13–16. Annual Conference of the National Association of Corrosion Engineers, Hotel Statler, N. Y.

June 18–22. A.S.T.M. Annual Meeting, Chalfonte - Haddon Hall, Atlantic City, N. J.

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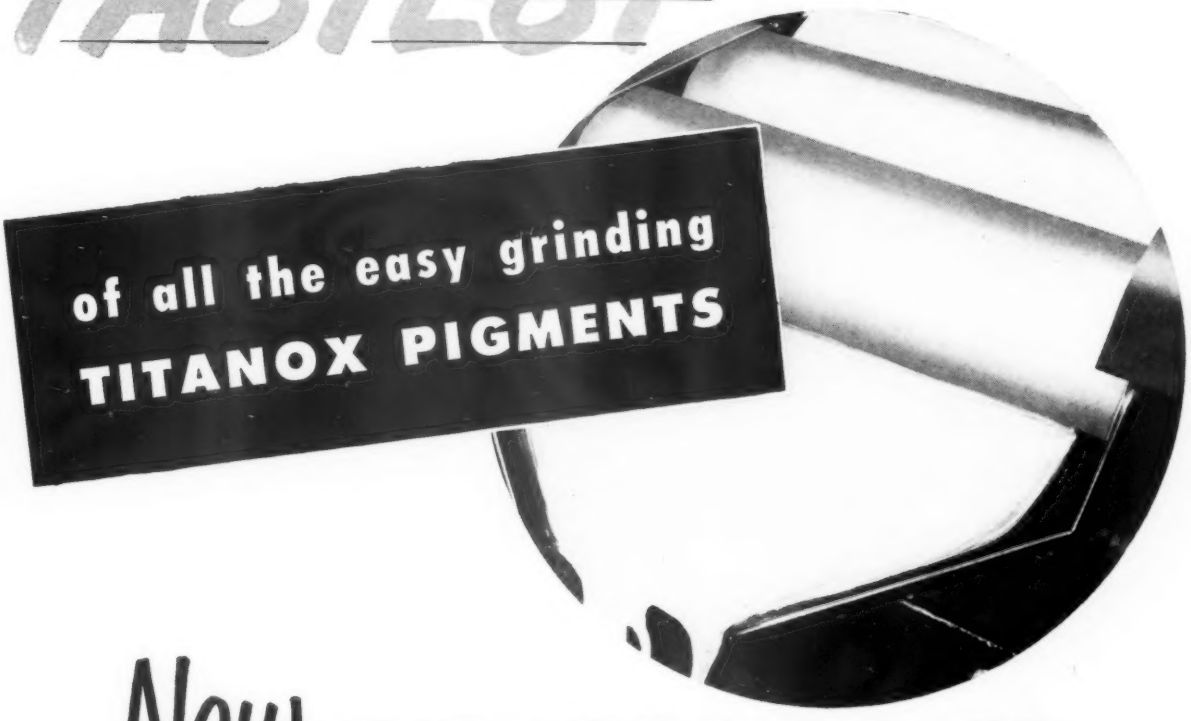

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